

Sandians Help Develop High-Temp Superconducting Circuits

During its short four-year history, high-temperature superconductor (HTS) research has uncovered a series of unusual properties that make even the most optimistic experts skeptical about HTSs in conventional superconducting electronics. Nevertheless, high-temperature superconductivity has progressed by leaps and bounds in some areas, and a recent breakthrough in Compound Semiconductor and Device Research Dept. 1140 could lead to a whole new family of electronics based on HTS transistors.

A team of Sandians and University of Wisconsin researchers has developed and used high-temperature superconducting transistors in a variety of working electronic circuits. This high-speed transistor, called the Superconducting Flux Flow Tran-

"The SFFT could be the building block for a whole new family of electronics."

sistor (SFFT), is an "active" device, meaning it has electronic switching properties (see "Fast-Acting SFFTs: How They Work" on page four). These properties are useful in electronic communications, microwave circuitry, and digital logic applications.

"The exciting feature of the SFFT," says Paul Percy (1140), "is that it exhibits high-speed, low-noise performance at relatively high temperatures. We're not sure yet, but it could be the building block for a whole new family of electronics."

A Big Deal

Superconductors are materials that allow electrical current to flow through them without resistance, or energy loss. Traditionally, materials have been superconducting only at very low temperatures. Until 1986, no known material displayed superconductivity above 25K (-248°C or -414°F). (See "Superconductivity:

A Simple Glossary" on page five.)

In 1986, IBM researchers discovered a new class of materials that displayed superconductivity at 30K, an important development because it meant superconductivity might ultimately take place at temperatures above 77K (-196°C or -321°F), the temperature of liquid nitrogen (a common and much less expensive coolant than the liquid helium used to cool conventional su-

perconductors). These new materials were ceramic instead of metallic, like the materials used previously.

Since then, scientists studying superconductors have been driving transition temperatures of materials higher in a dramatic worldwide pursuit that has attracted great public attention. In February 1987, the Sandia team, along with the Wisconsin (Continued on Page Four)



"GROWING" SUPERCONDUCTING thin films on a substrate with an electron-beam evaporator are Tom Zipperian (back) and Thomas Plut (both 1141). Electron-beam evaporation deposits thin films by directing a high-energy electron beam onto a material, which heats and evaporates the material, causing atoms to leave it and be deposited onto the substrate.

Contact Property Reapplication Now, Say ES&H Advisors

This is the first in a series of "helpful hint" columns as we prepare for the visit of the DOE Tiger Team (Environment, Safety, and Health inspection team) next year.

TIGER TEAM TIPS As Sandians prepare for the 1991 Tiger Team inspection, an emphasis on housekeeping will mean, for many, a call to Property Reapplication. Now is a good time to start, say the Labs' ES&H advisors.

Sandia's Property Reapplication Div. 3414 has established a driver-inspector team to arrange inspection, pickup, and transportation of reclaimed items. The division plans to add a second team within the next few weeks. Call Jim Sanchez, 4-7597, or Bonnie Hoffheins, 4-2171, to have excess materials scheduled for inspection and transportation.

The teams are designed to inspect items in place, then move them immediately, explains Dan Poole, 3414 Supervisor. This helps ensure that no hazardous materials reach the public through auction or other means, Dan explains. In the past, the lag time between an inspection and pickup meant that items could possibly be removed from a shipment or added without the inspector's knowledge.

This procedure, like many being instituted, is in the public and employee interest. It also means that Property Reapplication's time must be tightly scheduled. Start now and be patient, Dan advises.



LAB NEWS

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Cooperation in Space

Soviet Space Mission Will Feature X-Ray Instruments Designed at Sandia

A Soviet spacecraft scheduled for launch in 1993 will carry an X-ray telescope designed by the Soviet Union and Denmark and an X-ray polarimeter designed by the United States, with help from Sandia. Hungarians will be responsible for the spacecraft's on-board computer system and its telemetry linkup with Earth, while astrophysicists from Columbia University, Italy, the Soviet Union, and Britain will analyze the scientific data col-

lected during the mission.

Though it is not the first space venture to pool the talents of scientists around the world, it is certainly one of the more ambitious.

Formally known as Spectrum Roentgen-Gamma ("roentgen" is the European word for X ray), the spacecraft will carry, in addition to the main telescope, an ultraviolet telescope, a gamma

(Continued on Page Nine)



MEETING OF MINDS — American and Soviet scientists discuss the engineering design of an X-ray polarimeter to be launched aboard a Soviet spacecraft in 1993. From left are Sandian Joe Chavez (9231), visitors Oleg Terekhov of the Soviet Union's Academy of Sciences Space Research Institute and Valentin Sysoev of the Babakin Scientific Test Center, Bob Novick of Columbia Astrophysics Laboratory, and Igor Lapshov of the Space Research Institute.

This & That

Next Issue Dec. 7 - It's that time of year when the LAB NEWS staff gets a short breather. We go three weeks between issues around Thanksgiving time, and several of us take this opportunity to get in a few vacation days. Our next issue comes out Dec. 7.

* * *

Quality: More Than A Buzzword - Several weeks ago, a Sandia tradesman came to our photo darkroom to reroute a water outlet that was too close to an electrical outlet. Our head photographer, Randy Montoya, mentioned that our request to have an eyewash station installed had hit a snag someplace and asked how we should proceed. "No problem," said Greg Earnest (7813). "I'll install one right now while I'm here." Thanks for the quality service, Greg.

* * *

Oh, CHUTE! - It appears that cooler weather has driven those nasty little type lice indoors again. From a photo caption on page one of our Nov. 2 issue: "The pilot chute [parachute] creates the force necessary to deploy a larger drogue shoot, which . . ." I sure hope it's a short winter.

* * *

But We Didn't Do These - Now that I've "fessed up" to our own shortcomings, I can't resist taking potshots at some other writing and proofreading - or lack thereof. From a memo about evaluating cost quotations: "The evaluation must be the product of a factual objective analysis of quantitative realism relative to the statement of work . . ." Whatzat? From a recent meeting announcement: ". . . a multidisciplinary project to develop a suitable methodology to address the safety and risk concerns of mad-made systems."

* * *

Anyone Seen This Person? - A certain unidentified person - "the responsible supervisor" - is supposed to be doing lots of things these days, according to all the official correspondence I'm getting. I need to notify this person about these assignments, so send him or her my way if your paths cross.

* * *

The "Longest" Sandian - It's been about a year since we noted who's been around the longest. As of the middle of last month, G. C. Hollowwa (3411) had 44.25 years of service, counting several years back in the late 1940s when he worked for what's now Los Alamos National Lab. Hot on G.C.'s heels is Jack Suttman (9135), with just over 44 years of service. Three other on-roll employees have more than 43 years of service: Robert Statler (7519), Homer Crumley (3722), and Fred Deiber (2853). Unless someone retired within the past few weeks, Sandia now has 34 employees on roll with at least 40 years of service.

Thanks for the info, Kevin McMahon (3532) - who will have two whole years of service if he hangs around for several more months.

* * *

Team vs. Committee - An accomplished, but only slightly famous, writer I know told me his version of the difference between a team and a committee: "A team gets some things done and occasionally decides that it's better not to do something, but a committee does nothing while continually adding to the list of things that need to be done." Makes me glad Sandia is forming teams these days instead of committees.

* * *

It's Got a Horn, Though - Now I know where Herb Pitts (3100) gets his penchant for quips. After shelling out about 18 grand for a new car recently, Herb's 80-year-old Okie pop, Louis, said he never dreamed that he'd pay that much money for anything that didn't have a doorbell on it. ●LP

feed back

Q: Both my spouse and I have participated for quite some time in the bond-a-month program. Now I have just learned [at time of last bond campaign] that savings bonds in \$50 denominations will no longer be available. We purchase one bond a month for each of our children to help finance their college educations. Now we are forced to decide between doubling our monthly bond expenditure or choosing another means of earning interest on our money until sufficient funds have accrued to purchase a \$100 savings bond.

There is another option: Withdraw from the company's bond participation plan and allow each child's savings account to earn interest on the money that would have been used to purchase a \$50 bond, then buy a \$100 bond every other month. Why are we forced to make this decision? Who is profiting from "holding" our money an

Got a Question or Suggestion?

Employees who have suggestions for improvements at Sandia or who need quick answers to Feedback questions are encouraged to telefax their suggestions/questions to the Employee Communications Div. 3162 at 844-0645. For additional information about how the system works, call Janet Walerow (3162) on 844-7841. She can also provide printed Feedback forms if you cannot locate one where they are stocked in common areas throughout the Labs.

extra month? On an individual basis, this represents only a small sum, but how many bond-a-monthers are there at Sandia? Or nationwide? Why not institute a program that allows those making the investment to receive the profits? Or how about allowing a charitable organization to reap the benefits?

Who benefits from this? Is there a savings account fund in which a holding institution keeps the interest earned on deposits for one to eight weeks? Can we have an equitable solution in which Sandia continues its excellent bond participation program, yet employees also get what is rightfully theirs?

A: The decision to raise to \$100 the minimum denomination of the savings bonds that may be purchased through a payroll savings plan was made by the US Treasury Department. According to the Federal Reserve Bank of Kansas City, the decision was based on the fact that the number of purchases of \$50 and \$75 denominations was relatively small, and it was not cost-effective for the Treasury Department to continue offering them. If that decision is reversed in the future, Sandia will again offer these denominations to its employees.

Sandia does not earn any interest on payroll deductions made prior to bond purchases. Such deductions are not held in a special account. Funds are drawn from a DOE account (US Treasury) by Sunwest Bank at the time of the bond purchase. No interest is earned from these funds. Payroll deductions not immediately expended by Sandia are not really on deposit anywhere. These funds are simply not withdrawn from the DOE account until the time of expenditure.

Paul Stanford (100)

Congratulations

To Caroline Tozzi (9119) and Mike Baird (7825), married in Albuquerque, Oct. 6.

To Diana Fortune (7414) and Lou Zelnio (9142), married in the Caribbean, Oct. 22.



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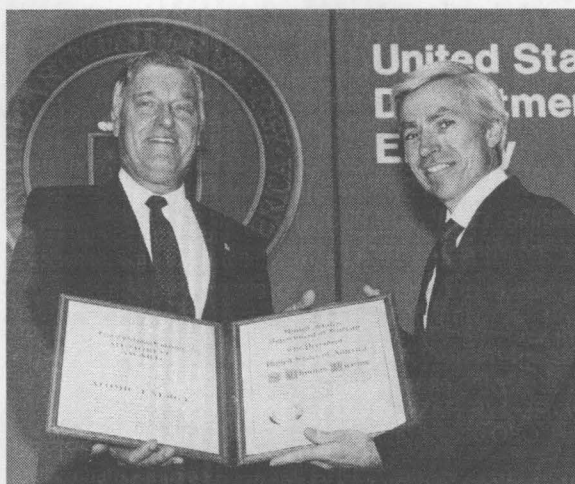
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SANDIAN HONORED - Materials scientist Tom Picraux (1110, right) received the 1990 E.O. Lawrence Award from Energy Secretary James Watkins during an Oct. 24 ceremony in Washington, D.C. The award, accompanied by a \$10,000 prize and a gold medal, is awarded to six scientists or engineers annually for outstanding contributions to the field of atomic energy. Tom was honored for developments in ion-channeling and ion-beam techniques for materials characterization, leading to improved microscopic understanding of materials (see LAB NEWS, Aug. 24).

Berkeley Biker

Sandian Describes Undergraduate Work With Sleek-Looking Bicycle

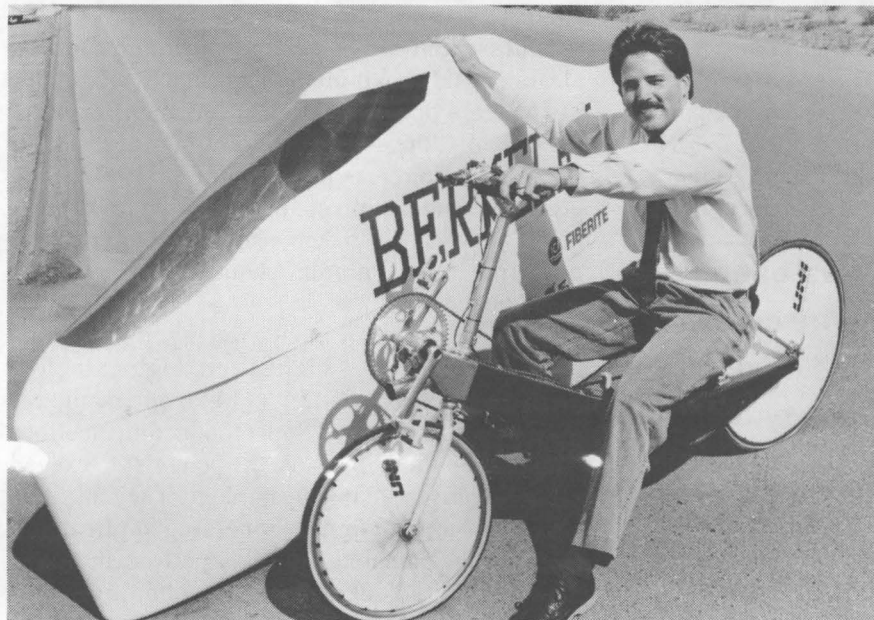
Sandians attending a recent talk by Bill Replogle (8441) about human-powered vehicles (HPVs) got a close look at the University of California, Berkeley (UCB) championship racer and how it was designed.

Bill directed the UCB Mechanical Engineering Department's competitive HPV project for the last two years as an undergraduate at Berkeley before joining Sandia. He was introduced to the class project shortly after he arrived at Berkeley in 1988 to work on his bachelor's degree in mechanical engineering. The project was his biggest extra-curricular activity during his two years at UCB.

The HPV class members welcomed Bill's talents and experience in design; he was soon assigned as co-director and then director for the project. "Each year the project begins with about 30 students, then dwindles down to five or six who are dedicated and willing to spend the extra hours to complete the fabrication and refinements in time for the two major competitions the school enters each year — regional collegiate and, later, international competition," Bill says.

Project members spend time in classroom sessions discussing the bike and fabrication of the aerodynamic composite shell (fairing) and hours in actual vehicle construction.

The UCB team took third place overall in the national collegiate competition during Bill's first year on the team. For the following year's competition, they redesigned the fairing to cut down on



SHOWING HOW the rider sits in a semi-recumbent position while pedaling the human-powered vehicle (HPV), Bill Replogle (8441) shows off Concept Z, the championship vehicle he helped design at the University of California. Behind him is the aerodynamic outer shell known as the fairing.

into the composite material, resulting in a smooth transition between the fairing and windshield. Finally, frame mounts were installed for mounting the fairing to the custom-designed bike.

The fairing was built so close to the bike and rider that only a quarter inch of space remained between the racer's shoulders and the interior of the fairing, and only a thin sheet of paper would slide between the shell and the bottom of the bike frame.

Another new feature was quarter-turn fasteners, typically designed for aircraft, that are flush with the shell. Instead of taping the two halves of the fairing together as most of the other HPV teams do, the new fasteners did the trick. This allowed the team to change riders more quickly than those teams who had to remove and reseal the shell with tape each time. A steering damper was also added to make it easier for the rider to maintain control of the bike.

The team's innovations paid off; UCB captured the championship title from 26 other colleges at the regional collegiate competition at San Jose State in April. The judging covers three events. The first event is a static judging, where vehicle design and appearance are rated; the team also gives an oral presentation about the testing and en-

gineering work. The second event is the sprint, in which a racer takes 700 meters to get up to top speed followed by 200 meters of top-speed timing (the UCB team achieved 45 mph in the collegiate race despite a 20-mph head wind and reached 53.4 mph at the international competition held at Visalia, Calif., last year). The third event is a five-rider relay road race covering 40 miles around a campus obstacle course.

Bill says he was able to transfer some of his newfound Sandia knowledge to this year's HPV team when he returned to campus as a guest lecturer. "I was impressed with a particular method of robust design that I learned from quality assurance seminars at Sandia," he says. "So I gave a summary of the experiment design techniques to this year's HPV project members. The engineering students can use this as a good learning tool if they adopt the techniques for the next competition."

Another recent hire at Sandia, Neal Fornaciari (8362), also participated in the HPV project part of the time he attended UCB. Both products of local valley high schools, Bill and Neal went through Las Positas College and Berkeley together, graduated in mechanical engineering, and have now begun careers at Sandia. ●BLS

SANDIA LIVERMORE NEWS

the wind resistance of the bike and rider. Team members reduced the frontal area some 20 percent and the surface area 6 percent by taking more exact measurements of the bike and rider, and designed the fairing using NASA wing profiles.

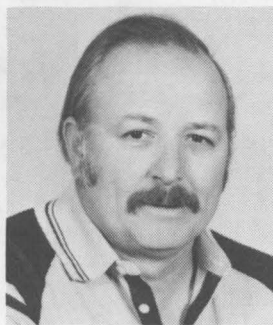
High-Tech Materials, Custom Design

To accomplish a sleeker design, they carved out a 10-foot "mold" from foam panels, shaving them into the exact shape they wanted. Then, a fiberglass material was spread over the mold. Once the fiberglass was set, the foam core was removed. Next, Kevlar™ and carbon fiber material were laid inside and held in place until they cured. The Lexan™ windshield was incorporated



COOPED UP — A Sandia team won several awards in a recent charity bed race to benefit the Kaleidoscope Activity Center, including Sweepstakes and Best Decorated Bed (for its chicken-coop theme). Navigators were (from left, front row) Sheryl Johnson (8161), coach Cindy English (8522), Kitty Blumberg (8446), Anton West (8446); (middle row) Jaimie, Ken (8272), and Erin Buck, Jack Bishop (8535), Darlene West (8161), Barbara Demo (8133); (back row) Ed English (8445), Dick Demo (8445), Geri Bishop, and Vic Ham (8313).

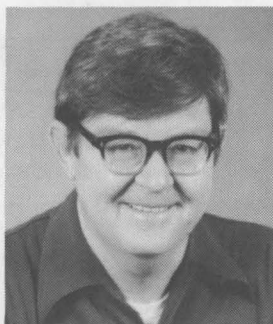
Recent Retirees



Jim Rego
8311 31



Gladys Kimberling
8534 30



Fred Whitworth
8526 31

(Continued from Page One)

Superconductors

researchers, attacked the problem of engineering circuit components made out of high-temperature superconductors; HTSs display superconductivity above the temperature of liquid nitrogen.

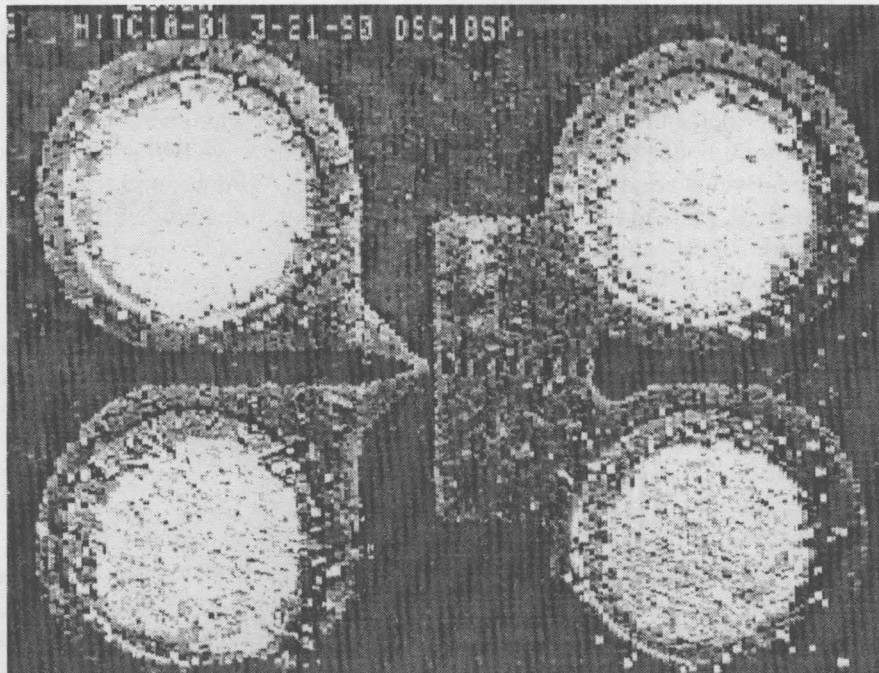
To achieve the needed high temperatures, the team used thin films of the thallium-based family of HTSs, which lose all electrical resistance at temperatures up to 125K and are super-sensitive to

“The rate of progress has been remarkable. We went from the concept to engineering a primitive device to using the device in a variety of circuits . . . all since early 1987.”

magnetic fields. During their first year of research, the Sandians made rapid progress developing thin superconducting films. Since then, they have joined up with the Wisconsin researchers to develop working circuits using thallium-based superconducting transistors.

“The rate of progress has been remarkable,” says Paul. “We went from the concept to engineer-

PHOTOMICROGRAPH of a Superconducting Flux Flow Transistor (SFFT), developed jointly by researchers at Sandia and the University of Wisconsin. Electrical current flows through the transistor from the source (upper right), through the weakened region of superconductivity (center), to the drain (lower right). Magnetic flux lines are introduced to the weakened region by the control line (the V-shaped point at the transistor's left). The large bright pads are silver contact metallizations. (See “Fast-Acting SFFTs: How They Work” below.)



ing a primitive device to using the device in a variety of circuits with a large number of applications — all since early 1987.”

Exciting New Electronics

So far the team has engineered SFFT-based amplifiers, oscillators, phase shifters, and mixers — all essential components in electronic communications and signal processing. The devices built by the team operate at high speed and high gain. Specifically, the amplifiers show significant gain (more power out than power in) of 10 decibels at 4 gigahertz, and the mixers operate at up to 35 gigahertz. They have also demonstrated prototype logic gates (the digital “on/off” elements in computers) based on the SFFT.

“The circuits all have exciting high-performance properties — high speed, high gain, low noise,” says Dave Ginley (1144), one of the researchers on the team. “Superconducting electronics based on the SFFT have the potential to exceed commercially available technology. They allow us to do a variety of signal processing applications and have the potential for higher performance than the competing semiconductor technology.”

Team members say that in the near term, the flux flow transistor could benefit the military as an element in phased-array radar antennas. Individual SFFT phase shifters in different antennas would control the radar signal's phase difference, provid-

ing higher-resolution radar information. SFFT components could also be used in satellites for data transmission. Eventually, SFFTs might be used by industry to enhance existing semiconductor technology or make higher-speed digital logic devices. There are other possibilities as well.

The high-gain properties mean that several SFFTs can be “stacked” to create a larger overall gain needed in many microwave applications. The high speed of the components is important for many high-frequency applications, especially microwave circuitry. High speed is useful in potential digital logic applications as well, such as high-speed computing.

“We are just getting to the point where we can begin to assess the SFFT's potential,” says Dave. “The SFFT is still in its infancy stage. It has potential, but we just don't know how much yet. Nobody knew how laser technology would progress when it was discovered, but now ‘laser’ is a household word.”

“Funneling” Current Flow

The team has already developed a linking device that serves as a converter between conventional, low-temperature superconducting electronics and semiconductor electronics. Paul likens the SFFT converting device to a funnel. If you want to hook a large pipe up to a small pipe, you need a funnel in between that adjusts the water flow from the large pipe to the flow allowed by the smaller pipe. The SFFT converts the impedance levels (degree of resistance) from the low-resistance super-

“The circuits all have exciting high-performance properties — high speed, high gain, low noise.”

conductors to the high-resistance semiconductor devices. “This could give existing superconductor technology a boost,” says Paul.

“The flux flow transistor is an excellent interface device,” says Jon Martens (1144), another team member. “The SFFT has gain and a whole variety of other interesting properties that make it perfect for enhancing existing technology. Now we're working to develop a technology around the transistor that includes passive and active superconducting components. We are developing a whole family of applications.”

(Continued on Next Page)

Fast-Acting SFFTs: How They Work

The Superconducting Flux Flow Transistor (SFFT) — the superconducting analogue to the much-used semiconducting field effect transistor (FET) — is an “active” device that switches between two states of conductivity. Dave Ginley (1144) calls these two states of conductivity “lossless” (no resistance) and “lossy” (some resistance).

The SFFT is capable of switching between these two states very quickly. The transistor works when current flows through a thin film of superconducting material. A source (current input) and a drain (current output) are hooked to opposite ends of the film, and a weakened region of superconductivity separates the two ends (see photomicrograph of the SFFT). This region of the film — made up of a pattern of weak superconducting links each approximately 10 micrometers long — operates as a gate, switching the current flow from “lossless to lossy,” or from good to poor conductivity. This gate is operated by weak magnetic fields.

When these magnetic fields are introduced to the weakened region by a control line (a tiny wire or point containing electrical current), narrow cylindrical magnetic force lines called flux lines penetrate the region. At liquid nitrogen tempera-

tures, these flux lines can move — or “hop around” — within the film's structure.

If the flux lines are stationary, the film is in a good or “lossless” state of superconductivity. But if the flux lines move easily within the crystal structure of the superconductor (called flux flow), some current is lost through resistance, and the film is in a poor or “lossy” state of superconductivity. Tom Zipperian (1141) says, “This high-speed switching between the two states of conductivity is what makes the SFFT so useful for communications, signal processing, and digital logic.”

Chris Tigges (1144), who helped optimize the SFFT material, says, “These are very fast devices — that's their main advantage right now. In the near term, they will probably be used in microwave applications. In the long term, they might be useful for digital logic, but that's not clear yet.”

The SFFT devices are kept cool by either immersing them in liquid nitrogen or by using cryogenic coolers, which use compressed nitrogen vapor to keep the circuits cool. Team members say keeping the devices below critical temperatures is not a problem, and that other technologies, such as the Cray computer, have been

successful using cryogenic cooling. Of course, the ultimate goal is to create materials that are superconducting at room temperature.

The thin films for the SFFT are made in a three-stage process. First, electron beam evaporation is used to “grow” thin films on a substrate by directing a high-energy electron beam onto a material source, which heats the material and causes atoms to leave it and be deposited onto the substrate. This step is repeated several times with different materials so that a layered film is created.

Next, the film is sintered — a heating process that fuses and arranges the atoms into the superconducting crystalline structure. Finally, annealing, another heating process in an oxygen-controlled environment, optimizes the oxygen content of the film.

The total thicknesses of the resulting films are 0.1 to 1.0 micrometer (about one-tenth the thickness of a piece of paper). To make a tiny transistor, optical photolithography is used to outline the shape of the transistor on the surface of the thin film. Then, surrounding thin-film material is chemically etched away with a solvent until only the superconducting transistor mounted on the substrate remains.

Honored for Work in Heat Transfer, Wind Turbines**Ben Blackwell Named ASME Fellow**

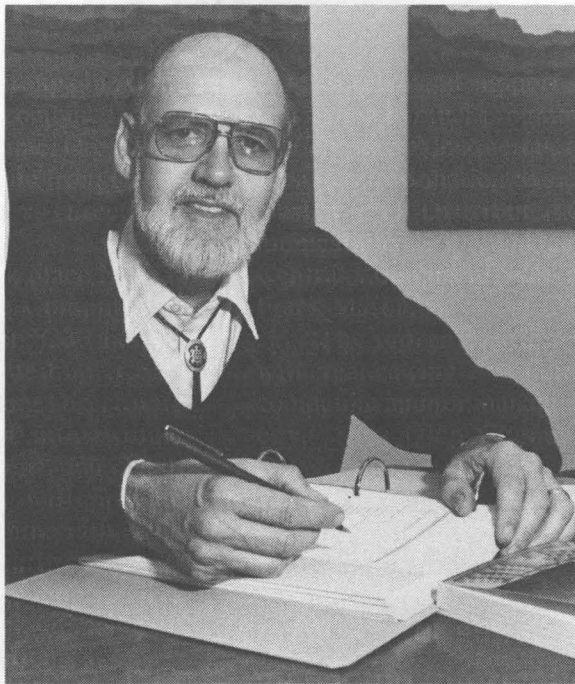
Sandian Ben Blackwell (1553), a specialist in heat transfer and aerodynamics and one of three researchers who developed Sandia's egg-beater style, 17-meter, vertical-axis wind turbine in the 1970s, has been named a Fellow of the ASME (American Society of Mechanical Engineers).

Replicas of the well-known wind turbine, called a Darrieus-type wind turbine in honor of the French inventor who came up with the basic design in the 1920s, are in wide use today in Northern California, where they generate electricity. Their efficiency is comparable to propeller-style wind turbines, which must be mechanically rotated to face the wind.

During the 1970s, Ben was project leader of Sandia's wind turbine research program and served as an advisor to various government-appointed scientific panels in the National Wind Energy Program.

Ben joined Sandia in 1965 shortly after earning a mechanical engineering degree from the University of Arkansas. He went on to earn a master's degree in mechanical engineering from the University of New Mexico and a PhD in heat transfer from Stanford University, both through Sandia-sponsored education programs.

During his Sandia career, Ben has worked on a diverse array of projects. Most recently,



BEN BLACKWELL (1553) is the ninth Sandian to be named a Fellow of the American Society of Mechanical Engineers.

these include thermal analysis of reentry vehicle systems for DoD reimbursable projects; development of computer codes to predict the thermal response of a vehicle to intense aerodynamic

heating; inverse heat conduction calculations, in which heat transfer rates are inferred from temperature measurements; and improvement and analysis of instrumentation to measure temperature and heat flux of reentry vehicles.

He is the author or co-author of more than 65 technical publications, including a textbook, "Inverse Heat Conduction — Ill-Posed Problems," and a chapter in the "Handbook of Numerical Heat Transfer."

In the 1980s, Ben studied problems related to the transport of spent fuel rods from nuclear power plants, including conducting open pool fire tests on nuclear transportation containers and experiments on natural convection in simulated fuel rod containers. In another area of energy research, he studied the heat transfer characteristics of aqueous foams for geothermal drilling.

As a member of the Aerospace Heat Transfer committee of ASME, Ben has co-chaired several ASME sessions.

Ben notes that he enjoys the diversity of assignments he has had at Sandia: "It's nice to have a variety of things to work on. There's always something different."

Ben is the ninth Sandian to be named an ASME fellow. The honor is reserved for about 1 percent of the society's total national membership of 125,500. ●LD

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Superconductors

Research on the SFFT has also led to the development of a circuit model of the device, which makes modeling new circuits possible without extensive testing. Team members took hundreds of measurements to understand the physics of the device.

"Now that we know the fundamental limits of the device and the equations that control how it operates, we can try different models without going to the lab and testing them," says Jon. "We have also discovered new measurement techniques, including a microwave technique for measuring surface resistance and other physical properties of superconductors."

True Team Progress

Team members say the success of the project would not have been possible without the continuing contributions made by every Sandia and Wisconsin researcher. Jon Martens and the other UW researchers, with Sandia funding, developed some of the first SFFT-based devices

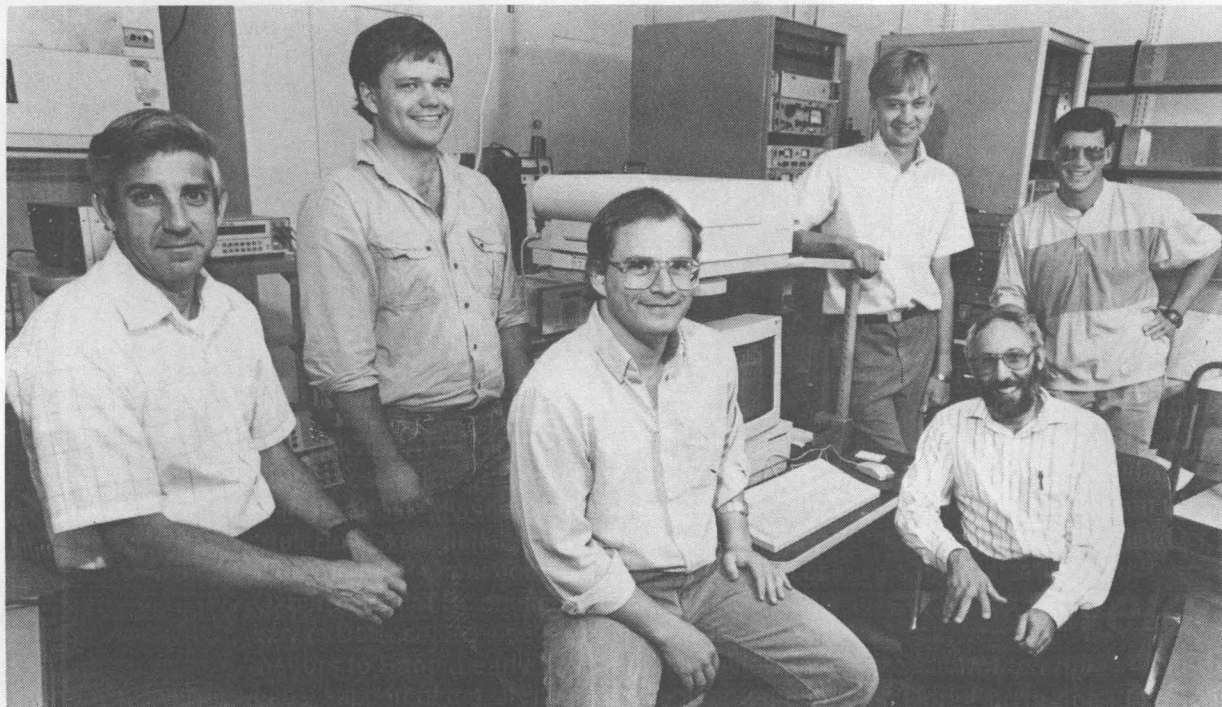
before Jon came to the Labs in March.

Eugene Venturini (1152), one of the Sandians who helped develop the films, says that there were some key researchers on the project, but that it was a team effort on a number of levels. The teamwork both within his division and within the entire department was gratifying. The group was featured in the March 9 LAB NEWS wearing team T-shirts.

Dave, Eugene, and Chris Tigges (1144) optimized the thin-film superconductors, and Tom Zipperian (1141) developed the essential material processing techniques. Jon and James Beyer (UW), James Nordman (UW), and Gerd Hohenwarter (UW) developed the SFFT, and Jon and Vincent Hietala (1144) developed the microwave components. "We really covered the gambit of skills found at an engineering lab like this one," Chris says.

"Not only are we developing a new device," says Dave, "but we are gaining a fundamental understanding of superconducting materials, which requires experience in physics, materials science, materials processing, circuit design, and testing. Sandia is one of the very few places in the world with the ability to do all that."

●JG/KFrazier (3161)



SUPERCONDUCTING SANDIANS are (from left) Eugene Venturini (1152, seated), Jon Martens (1144), Chris Tigges (1144, seated), Vincent Hietala (1144), Dave Ginley (1144, seated), and Tom Zipperian (1141). University of Wisconsin researchers (not shown) include James Beyer, James Nordman, and Gerd Hohenwarter.

**Superconductivity:
A Simple Glossary**

Superconductors — Materials that allow electrical current to flow without resistance (without dissipating energy).

High-Temperature Superconductors — Superconducting materials that have critical temperatures above 77K (-196°C or -321°F), the temperature of liquid nitrogen, a common and inexpensive coolant.

Type II Superconductors — Superconducting materials that, when penetrated by magnetic fields, confine the magnetic field to lines of equal magnetic force, called flux lines.

Thallium-Based (TI) Superconductors — Class of high-temperature superconductors that contain thallium and are currently being studied at Sandia for their high critical temperatures (see below) and sensitivity to magnetic fields.

Critical Temperature (T_c) — Transition temperature below which a given material has superconducting properties, such as zero resistance. Until 1986, no known material became a superconductor above 25K (-248°C or -414°F).

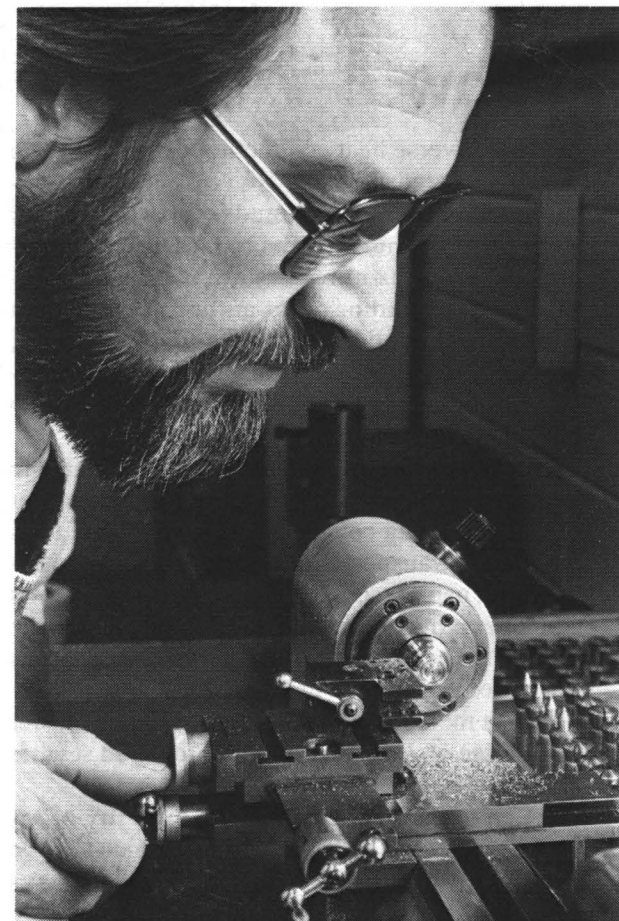
Flux Lines — Lines of magnetic induction (one-millionth of a centimeter in diameter) that penetrate a type II superconductor, often favoring defects in the material. Each flux line contains the same amount of magnetic flux (force).

Flux Flow — Energy-dissipating movement of flux lines within a superconductor, controlled by changes in magnetic fields. Flux flow switches the Superconducting Flux Flow Transistor (SFFT) from resistant to non-resistant quickly.

Electron-Beam Evaporation — Process for "growing" thin films on a substrate by directing a high-energy electron beam onto a material, which heats and evaporates the metal, causing atoms to leave the material and be deposited onto the substrate.

Sintering — Process for fusing and arranging tiny crystalline grains of thin-film materials by heating the film to just below its melting point in a controlled atmosphere.

Annealing — Process for optimizing the oxygen content in thin-film materials by heating in an oxygen-controlled environment.



PINHEAD-SIZED PARTS can be machined in the miniature shop, as José Padilla (7485) shows, using a jeweler's lathe.

Big Shop Does Big Stuff & Small Stuff

The "Big Shop" in Bldg. 840 is a place where Sandia engineers have had ideas turned into reality for more than 40 years. The machinists of Dept. 7480 turn schematic drawings and raw metal stock into precision components.

"Engineers often come to us first to get help on how to best produce a part they are designing," says Charlie Salazar, Supervisor of Heavy Machining Sec. 7482-2. "They get ideas about how to tighten or loosen tolerances to enhance part manufacturability."

The specialists are capable of machining parts that are smaller than a pinhead or that weigh as much as 20,000 pounds.

Computer-aided numerical-control machining has improved the abilities of today's machinist to complete more complex projects in less time and with more efficiency. Traditional disciplines have not been forgotten, however. "Conventional machining as a craft is still needed every day on experimental parts," says Charlie.

The machinist's job is to keep up with the fast-changing world of manufacturing technology. Al Garcia (7482), a 31-year-veteran, says nine out of ten times it is possible to make ideas more feasible and economical for development with the applied knowledge of Sandia tradesmen.

"In Division 9143, we design very accurately scaled wind tunnel models of flight vehicles that must be made to extremely tight design tolerances," says José Suazo, a 33-year customer of the Big Shop. "We give them some very difficult jobs, but they're extremely good. Many shops couldn't even do this work."

"It takes lots of patience to work in the Big Shop," says Charlie. "Working with your hands and making a product out of a raw piece of stock is challenging but fun for these folks. And it's never boring — we have some real characters who work here."

Most of these machinists and others who work elsewhere at Sandia learned their trade in an apprenticeship program that's jointly managed by the Labs and their union.

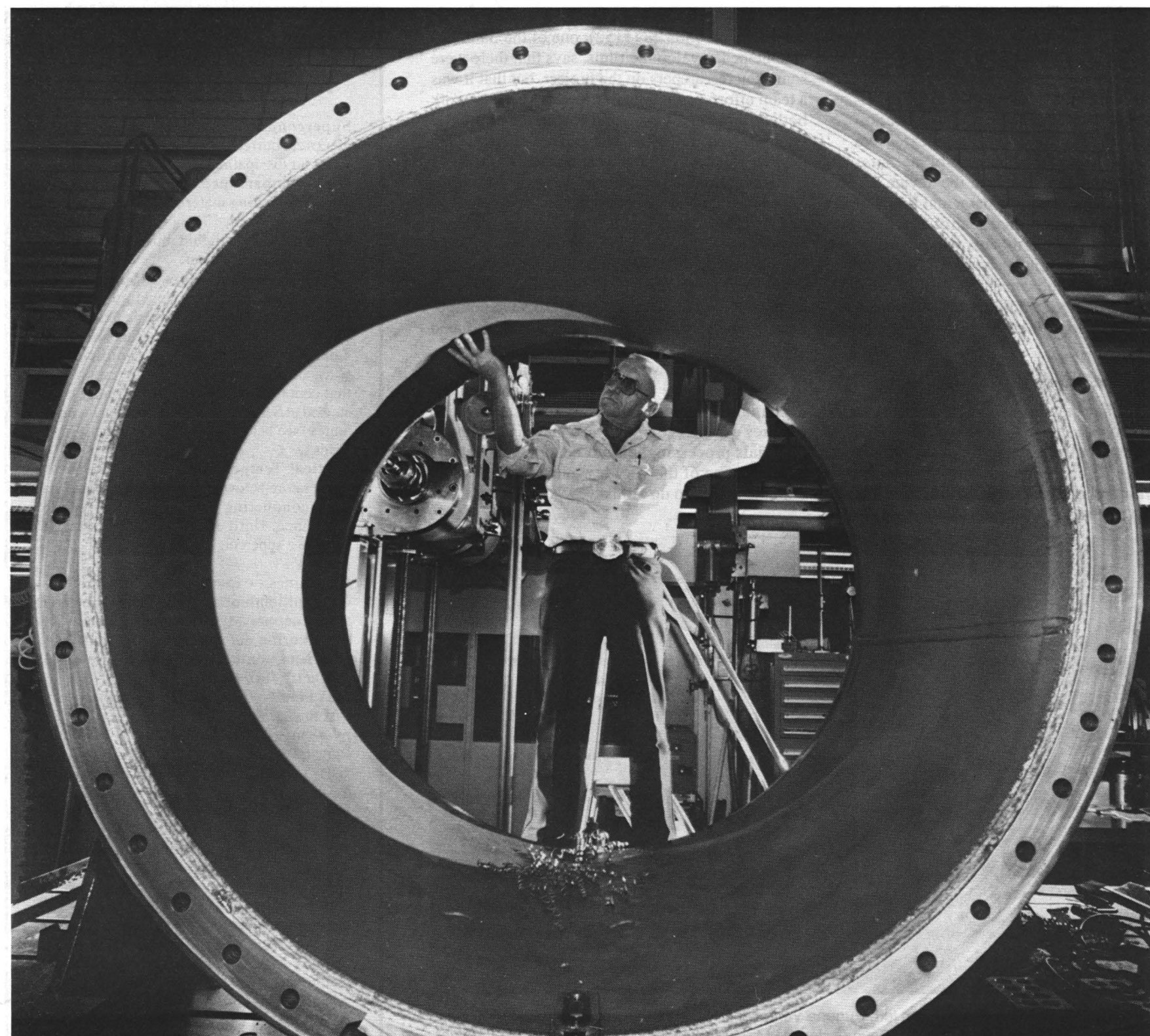
In an average year, the Big Shop handles more than 3,000 job requests, which are worth about \$12 million.

"It's amazing how far we've come in just a few decades," says Kyle Williams (7481), a graduate of Sandia's first apprenticeship program in 1960. "At one time I was doing things the old-timers had never seen done. Now, 37 years later, I'm seeing some of the new folks doing things that I never dreamed about. I guess that's how it should be." ●RM

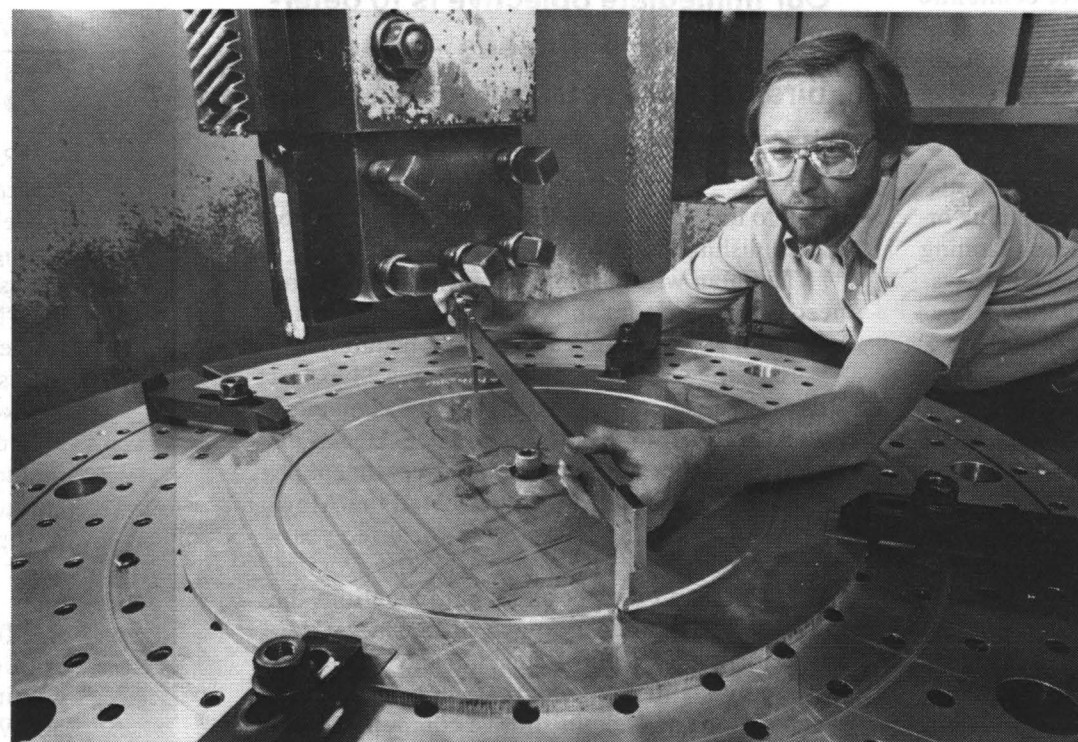
(Photography by Randy Montoya, 3162)



SPLASHING WATER-BASED coolant assists the process as Tim Mitchell (7482) turns a part in the 32-inch lathe.



STEVE GERHARD (7482) works on drill patterns for one of the larger parts that the Big Shop handles.



RICK ANDERSON (7482) uses a vernier to measure an O-ring's groove diameter. The 72-inch vertical lathe he is using is capable of handling a part seven feet tall.



STAINLESS STEEL vessel lids await a craftsman's finishing touches.



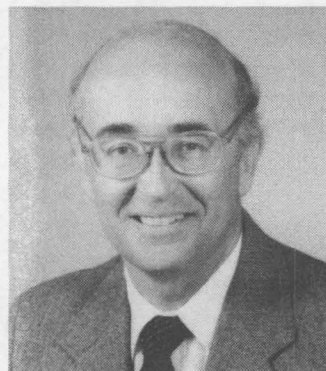
JUANITA SANCHEZ (7481) uses the Big Shop's medium-sized vertical milling machine to drill and countersink precision holes in an aluminum part.

Reorganization to Improve Cost Effectiveness

Computer Operations Combined Into New Directorate

Sandia's central computing groups in Albuquerque and Livermore have been combined into a new Corporate Computing Directorate, Org. 2900. Ron Detry leads the new directorate from Livermore, where he continues to serve as Director of Engineering Design 8200.

The consolidation, which took place Nov. 1, combines the former Livermore Computation Dept. 8230 and Albuquerque Computing Directorate 2600 into a single organization (2900) that will provide administrative and scientific supercomputing services for Sandians in all locations.



RON DETRY heads new Corporate Computing Directorate 2900.

All mainframe supercomputers will eventually be housed in Albuquerque. State-of-the-art equipment allowing remote access to the mainframes will be installed in Livermore.

Project Plan by Feb. 1

No timetable has been established yet, but Ron is working with Livermore and Albuquerque computing specialists and administrators to develop a project plan for centralizing the equipment and serving user needs both during and after the transition. The plan should be completed by Feb. 1.

People who were in 8230 are now assigned to the new Livermore Computation Dept. 2910, managed by Dona Crawford. When the transition is complete, some of the staff will remain as com-

puter service and support staff and some will be reassigned to other programs, says Ron.

The new Albuquerque-based departments are Business Information Systems 2920, managed by Karl Waibel; Distributed Computing and Communications 2930, managed by Craig Jones; and Central Computing Systems 2940, managed by Frank Mason.

"The reorganization and equipment move will create a single corporate resource for supercomputing and for managing information technology," says Glen Cheney, VP of Component Development 2000. "We also intend to create the

"The reorganization and equipment move will create a single corporate resource for supercomputing and for managing information technology."

opportunity for a closer alignment of scientific supercomputing with the research in massively parallel computing that's going on in the Computer Sciences and Mathematics Directorate 1400.

"Both of these ideas mesh with Sandia's strategic intent to create a stronger, more cost-effective Sandia," continues Glen. "There are economic motivators — we expect to save money by centralizing our computing operations, eliminating duplication of services in separate facilities, and having our computing specialists in all locations work closely together."

Sandia's Management Council has been discussing a consolidation of the Labs' computing organizations for some time and has been planning this reorganization seriously since June, Glen says.

The reorganization and Ron's appointment as

Director of Corporate Computing were announced in Livermore on Oct. 29 by John Crawford, VP of Livermore Programs 8000. In his announcement to Livermore employees, John said the transition will be implemented in a way that will continue providing first-class supercomputing at Livermore.

John emphasizes to the LAB NEWS that the Sandia Management Council is determined that the reorganization will not diminish scientific supercomputing capabilities in Livermore: "Our goal is to strengthen our computing capabilities for all Sandians at the same time that we make our operations more efficient."

A Technical Challenge

"Consolidation of equipment and elimination of duplicate services is important to the future of the Labs, and we're definitely going to see more of this throughout the Labs," continues John. "Our technical challenge in this case is to learn how to do first-class scientific supercomputing at a distance."

Ron adds, "Our immediate objective is to determine everyone's needs — user requirements — and then to decide what we can do technically to serve these needs. We'll incorporate this informa-

"Our immediate objective is to determine everyone's needs — user requirements — and then to determine what we can do technically . . ."

tion into the Feb. 1 project plan, our 'road map' for accomplishing it all."

The plan will define equipment and staffing needs for Livermore and Albuquerque, the series of steps that will be taken, and the schedule.

Executive VP Orval Jones (20) says, "I expect Ron Detry to do a fine job directing the computing groups in Livermore and Albuquerque. He has directed the Livermore Computation Department [as part of 8200] since 1986 and directed the Albuquerque Computing Directorate for three years before that.

"Ron knows the people in both locations, he knows our needs, and he knows his business," Orval continues. "With his leadership and everyone's cooperation, I'm confident that our scientific supercomputing and administrative computing capabilities will become more cost effective while we continue to be a world leader in developing and applying advanced computing technology."

(Editor's Note: Sandia is indeed a world leader in advanced computing technology. Sandians in Livermore and in Albuquerque won two R&D 100 awards in 1989 for developing new mathematical methods and algorithms for parallel computing and for developing software for distributed parallel processing (LAB NEWS, Oct. 6, 1989). Research and Development magazine sponsors these annual awards, which recognize the "100 most significant new technical products" of the year.)

•LP



VIEWING SRAM-T MODEL — Dave McVey (5161) discusses status of Sandia's work on the Short Range Attack Missile — Tactical (SRAM-T) with Prof. Ron Oxburgh (left) of the United Kingdom and Executive VP Orval Jones (right, 20). Professor Oxburgh, Chief Scientific Advisor to the UK Ministry of Defence, led a seven-member delegation of visitors to Sandia early this month to review the Labs' support of the UK nuclear weapon program. The visitors also toured robotics research projects in Computer Sciences and Mathematics Directorate 1400 and discussed possible future joint weapons projects.

Earnings Factors August 1990

Long-Term Savings Plan for Management Employees (LTSPME)	Earnings Factors
AT&T Shares	.8739
Government Obligations	1.0021
Equity Portfolio	.9057
Guaranteed Interest Fund	1.0074
South Africa Restricted Fund	.9181

Long-Term Savings and Security Plan (LTSSP)	Earnings Factors
AT&T Shares	.8754
Guaranteed Interest Fund	1.0070
South Africa Restricted Fund	.9189
Equity Portfolio	.9054
Employer Stock Fund	.8746

Sympathy

- To Ahmed Badruzzaman (9352) on the death of his father in Dhaka, Bangladesh, Oct. 24.
- To Mark Richards (9224) on the death of his mother in Newfoundland, Canada, Oct. 26.
- To Merle Benson (2624) on the death of his father in Albuquerque, Oct. 29.

Welcome

Albuquerque — Melissa Burleson (21-1), Dora Carrington (3426), Shirley Parker (22-2), Pamela Tyler (3141), Sharon Voccio (22-2).
Elsewhere: California — Curtis Nelson (6419); Indiana — Jeffrey Whitlow (6321); Maryland — Paul Robinson (9400).

Retiree Deaths

- Lee Stinnett (70)Sept. 26
- Roy Hay (76)Oct. 4
- Alfredo Chavez (82)Oct. 7
- George Hawley (79)Oct. 11
- Lessel Lamkin (77)Oct. 12
- Ernst Krahling (80)Oct. 13
- Raymond Clark (69)Oct. 13
- Robert Parry (73)Oct. 26
- Robert Scalf (67)Oct. 30



(Continued from Page One)

Soviets

burst detector, two smaller, independently steerable X-ray telescopes, and a host of support systems built around the world.

In the US, the Stellar X-Ray Polarimeter is a collaborative effort of Columbia University, Sandia, Lawrence Livermore National Laboratory, and NASA's Marshall Space Flight Center. The other American experiment on board, called the All-Sky Monitor, will study "soft" X rays and is being built by Los Alamos National Laboratory.

Of course, coordinating such a diverse effort is a monumental task. It requires a great deal of communication between scientists and engineers who speak different languages and live in countries separated by thousands of miles. Sandian Pat Newman (9112), the Labs' official translator, has helped things run smoothly by translating and interpreting between English and Russian.

Sandia is designing the data processing system for the X-ray polarimeter as well as the precision mechanical components, electronic packaging, and controls. The actual X-ray detector is being devel-

"Since the measurements have never been made before, we really don't know yet what we'll find."

oped by Columbia. Once launched, the polarimeter will operate for three years.

"A unique feature of this X-ray mission is the polarimetry — the instrumentation designed to measure polarized X rays coming from cosmic sources," says Dick Spalding, Manager of Sensor Systems Dept. 9230. "That's something that hasn't been done before with anything approaching this sensitivity."

Balloon Fiesta Highlights Visit

Last month, nine Soviet scientists and engineers from the Institute of Space Research and the Babakin Center, where the spacecraft is being designed and assembled, visited New Mexico to finalize engineering designs. Joining them were three Italian scientists, a Hungarian engineer, a British scientist, and a Finnish scientist.

One of the more complicated aspects of such an endeavor, explains Joe Chavez, Supervisor of Sensor Systems Div. 9231, is getting the American-made instrument to work with the Soviet-made spacecraft. Seemingly simple things like bolt patterns can involve a lot of effort. They all have to match up to very close tolerances and the electronics have to be compatible before the spacecraft can take off.

The foreign visitors' New Mexico visit was not limited just to business. During their stay, they were introduced to some of the cultural life of the American Southwest. They were given hot-air balloon rides by local pilots during Albuquerque's world-famous balloon fiesta, watched local dancers perform traditional Indian and country-western dances, and toured Canyon de Chelly and Navajo country, in addition to holding two weeks of meetings with scientists and engineers from Sandia and Los Alamos laboratories.

Pat, who is also an electrical engineer, spent three weeks interpreting for Soviet visitors during meetings and escorting them to the various sites of interest. (In addition to her work at Sandia, she serves on the board of directors of the American Translators Association.)

Search for Polarized X-Ray Emissions

The polarimeter is a specialized telescopic instrument designed at Columbia University to look for polarized X rays. It works together with the X-ray telescope, called SODART (for Soviet-Danish Roentgen Telescope). Like other instruments on



UP, UP, AND AWAY — Translating sometimes involves more than making a foreign language intelligible to those who don't speak it. In this case, Sandia translator Pat Newman (9112) accompanies Soviet visitor Nikolai Rempel, of the Special Design Bureau of the Soviet Union's Space Research Institute, on a balloon flight during Albuquerque's recent balloon fiesta. Says Pat, for whom the balloon ride was her first, "I asked our guests at the end of their visit to New Mexico what was the most memorable part of the trip. Balloons are rare in the Soviet Union, and for nearly all of them, the balloon flight was near the top of the list."

the spacecraft, it can be inserted into the main X-ray telescope, similar to the way slides can be switched on a microscope.

All light has a certain polarization caused by the electrical field orientation of individual electrons, explains Joe. Polarization is similar to a wave at the end of a vibrating string or rope, he says. If one tries to slip the rope through a picket fence, it can be done only if the waves are moving up and down rather than back and forth.

Astrophysicists theorize that exotic objects, such as black holes and neutron stars, may emit polarized X rays, notes Dick. One possible inference is that polarization is the result of strong magnetic fields and the motion of electrons within those fields.

"But since the measurements have never been made before, we really don't know yet what we'll find," says Joe. Past satellite experiments have measured the energies of X-ray emissions, but few have looked for polarization.

The X-ray polarimeter will also be pointed at ordinary stars to see if they produce X rays with a dominant polarization.

Sandia was asked to design the operational components and structure of the polarimeter by Columbia University. Scientists at Columbia had worked with Sandia before on another project, the Uniformly Redundant Array, an X-ray telescope scheduled for launch aboard the space shuttle early next year.

If all goes as planned, Sandia will deliver an engineering model of the polarimeter to the Soviet Union next spring, says Dick. Assuming the design is compatible, Sandia will deliver a flight model in spring of 1992, which will be installed on the spacecraft and tested for flight readiness.

Sandia's work on the X-ray polarimeter is a collaborative effort. Responsible for electronic packaging are Kate Scurry and George Peterson (both 9213). Mechanical design and structures are by Bob Woods (9231), Howard Seltzer (9234), and Gary Ahasteen (9231). Electrical design is by Jim Daniels and Gene Kallenbach (both 9233); thermal design by Ron Akau and Jaime Moya (both 1513); and power supplies by Terry Ellis (9231), Fred Wymer (9211), and Harvey Temple (9116). ●LD

US-Soviet Cooperation in Space Fairly New

Sandia's work with Columbia University on the Stellar X-Ray Polarimeter was made possible by the US-USSR Agreement on Space Cooperation, signed in April 1987 while then-President Reagan was meeting with Soviet President Gorbachev in Moscow.

A panel of scientists, called the US/USSR Joint Working Group on Astronomy and Astro-

physics, was formed as a result of the agreement to study potential joint projects. NASA invited the American scientific community to submit proposals for the Spectrum X-Gamma mission in September 1988.

Sandia helped Columbia write the polarimeter proposal, which won acceptance by both NASA and the Soviets, says Joe Chavez (9231).

feed *li*back

Q: With the increased awareness of energy issues as a result of recent international events, why doesn't Sandia use the VAWT to put power into the grid and reduce our energy bill? I haven't seen it running for the past six months.

A: Sandia's 17-meter Vertical Axis Wind Turbine (VAWT) is a research machine that never was intended to be run on a full-time basis (its components were not all designed for thousands of hours of operation). In addition, funding levels over the past two years have caused us to curtail its operations in favor of its next-generation replacement, the 34-meter VAWT Test Bed just west of Amarillo, Tex. One of the reasons Amarillo was selected over Albuquerque is that winds in Albu-

querque simply are not good enough to justify the costs associated with regular operation of the machine.

On the positive side, however, the commercial progeny of the 17-meter VAWT number more than 500 units in California and have a combined power rating of just less than 100 megawatts. Last year, these turbines accounted for a significant portion of the 2.1 billion kilowatt-hours of wind-generated electricity (which was about 1 percent of California's total consumption). So while your observation is correct that the turbine has not been running, it in fact has had an important impact; we hope to continue to utilize it for specific research activities in the future.

Bill Marshall (6200)

Small Success, Big Benefits

One Sandian's Vision Benefits Project Leaders Labs-Wide

In July, when project leader Gene Roseth (9242) began requesting part-time help for his project through the *Weekly Bulletin*, he was experimenting not only for himself but for all of Sandia.

His idea was to tap Sandia's most important resource — its technical expertise — for his project, and his success means that project leaders Labs-wide can now "borrow" technical help from other divisions for short-term projects.

"Most project leaders, like myself, need a lot of different talents," says Gene. "But there was no formalized structure for borrowing employees from another division for, say, 10 hours a week, even though some employees have time available. The part-time job ads can help fill the gaps without the hassle and expense of hiring a new person and then having an 'orphan' when a project is completed."

When an employee responds to a part-time job posting in the *Weekly Bulletin*, the project leader who placed it and the employee's supervisor meet to agree about how much of the employee's time can be spared for the project. Employees selected for part-time projects will charge a fraction of their work time to the project organization until the project is complete. Filling project assignments this way is quicker and easier than Sandia's traditional post-and-bid system, and that's why Gene thinks project leaders will be attracted to it. (See "Posting Part-Time Job Ads: Here's How.")

Success Story

Gene's project involved a weapon-tagging scheme for verifying treaty compliance, which

was being developed at Lawrence Livermore National Laboratory. His job was to assemble a team to pinpoint the tagging scheme's vulnerabilities, which required him to recruit experts with various and far-reaching experience in treaty negotiations, mechanics, engineering, chemistry, statistical analysis, fiber optics, and other fields. He asked for help within his department, but soon realized he would have to go elsewhere to find such a range of technical knowledge.

"This informal method of project staffing really makes sense," says Gene. "Project leaders can select the type of help they need for the time

Project leaders Labs-wide can now "borrow" technical help from other divisions for short-term projects.

they need it. When the project is finished, the employee goes back to working full-time in his or her own division."

Gene says 21 Sandians responded to the part-time job postings in the *Weekly Bulletin*. He selected seven of them to work on his project, and he may use others in future projects.

Al Villareal of Personnel and General Employment Div. 3533 says part-time job postings require some coordination between organizations but reduce the amount of paperwork, such as formal approvals and detailed reviews, characteristic of the post-and-bid system. It also helps alleviate the occasional work-load imbal-

ances among organizations.

"Gene's method of recruiting takes advantage of Labs people who may occasionally have extra time on their hands," says Al, "and increases a project leader's chances of getting proven talent. Gene's idea is 'all-gain,' so let's use this method Labs-wide."

The Good and the Bad

Gene says his recruitment method works because it is simple and informal, but should be used only when other methods aren't effective. "This method probably is not for everyone," Gene says. "Some project leaders can round up enough people by word-of-mouth. But this method gives project leaders the individual freedom, or empowerment, to manage their own projects."

Critics of matrix management — an approach that allows project managers to go outside the traditional structure and tap resources of other organizations — say part-time project work can be detrimental to an employee's performance reviews if the project work is not included in the performance review; the employee's contact with his or her supervisor is reduced, often leading to a performance appraisal that does not take into consideration work outside the division.

"This problem is usually solved with a simple evaluation letter from the project leader to the supervisor after a project is finished," says Gene. "It is important that the project leader be included in the feedback loop."

"Gene's idea is an example of one Sandian finding imaginative ways to make projects work," says Al. "I hope it will lead to new ideas from other Sandians. Small successes like this are what President Al Narath meant on Vision Day when he asked individuals to help fulfill the goals of Sandia's Strategic Plan." ●JG

Posting Part-Time Job Ads: Here's How

Step 1: Establish a list of necessary time requirements and technical expertise to be fulfilled by part-time specialists from other divisions.

Step 2: Submit a part-time job ad to Personnel and General Employment Div. 3533 for publication in the *Weekly Bulletin*. Be sure to include the title of the position, a brief description of the time requirements and technical expertise established in Step 1, and your phone number. Call Mark James (3533) on 4-5656 with questions.

Step 3: Interview on-roll, full-time Sandians who respond to the posting.

Step 4: After all respondents are interviewed, select those who meet the requirements

from Step 1 and who will best contribute to the project. Notify those who are not selected.

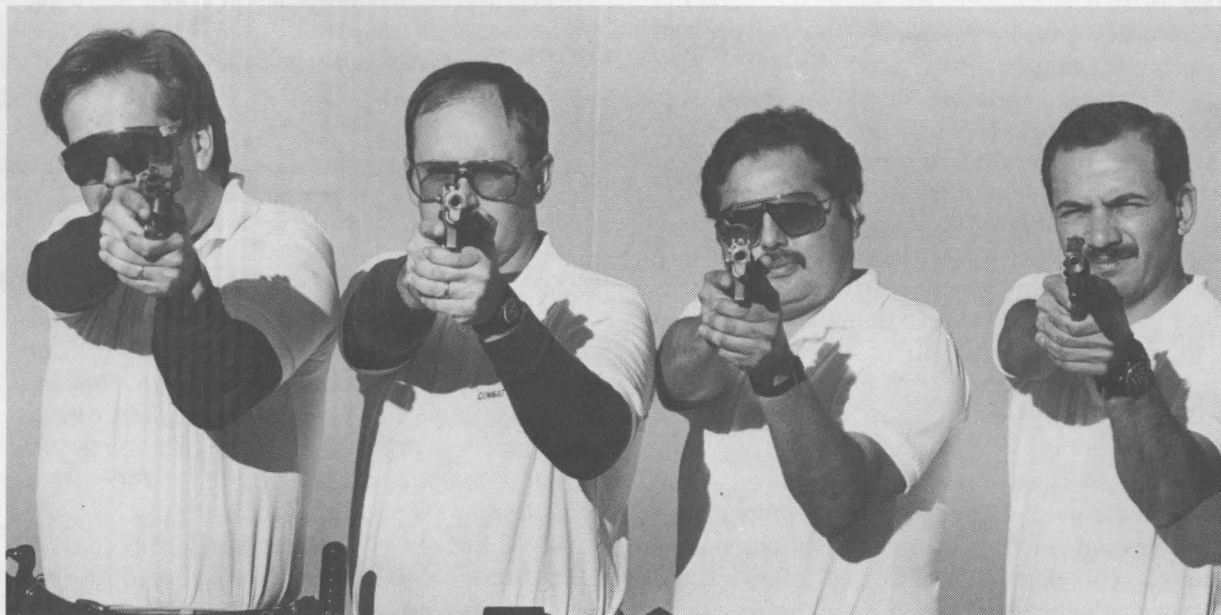
Step 5: Meet with each selected employee and his or her supervisor. Reach a formal agreement about the employee's schedule and the expected duration of the project. After this meeting, write a letter summarizing these agreements and send a copy to each employee and supervisor.

Step 6: Give each selected employee the project's case number. The employee will charge a percentage of his or her time to that number.

Step 7: Send memos about the employee's performance to his or her supervisor at appropriate intervals during the project and after the project is complete.

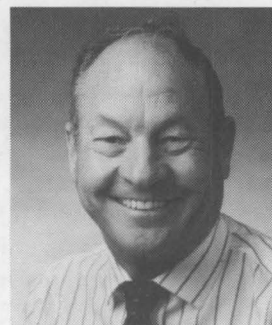
Fun & Games

Swimming — Kirtland Aquatic Club is a nonprofit, year-round competitive swim team for all ages. KAC is a member club of United States Swimming, the national governing body for amateur swimming; most US International and Olympic swimmers are members. KAC operates under the aegis of the Kirtland Youth Center. In order to join the team, a normal one-time MWR (\$10) fee must be paid. The club swims at the Kirtland Olympic pool, and membership is mainly from the Air Force, Sandia, DOE, and contractor families. Most members are swimmers between the ages of 6 and 20, but a separate Masters program is offered for those who wish to swim and occasionally compete with others beyond their early 20s. Learn-to-swim programs (with lots of individual attention) are offered throughout the year at reasonable rates. An MWR fee is not required to participate in this program. For information, contact KAC president Dale Berg (6225) on 296-2695.



SANDIA'S SECURITY PISTOL TEAM targeted the Las Vegas Desert Regional Police Pistol Tournament Oct. 10-13 and won first place in the four-man team competition. Demonstrating their aims for LAB NEWS photographer Randy Montoya are Shane Murray, David Stout, Ernest Torres, and Anthony Aragon. The tournament drew 330 law enforcement officers from 27 states and 5 countries. Other Sandia participants included Tommy Serna and Gary Malin who placed fourth in the two-man team match. Ruben Padilla placed third in the individual marksman category, and Ernest placed tenth in the individual master category. Sandia's team is coached by Capt. Harold Garcia. Pistol Team members are from Patrol Div. 3435. The team is now aiming for wins at the Territorial Police Pistol Tournament in Mesa, Ariz., Dec. 15.

Recent Retiree



Earle Chapman
5113

31



Take Note

The provisional class of the Junior League of Albuquerque and the Rocky Mountain Adoption Exchange are co-sponsoring a parent education seminar for individuals who may be considering adoption of special-needs children. A panel of professionals and parents will answer questions. The seminar will be held Tuesday, Nov. 27, from 6:30 to 9:30 p.m. in Coronado Center's Coronado Community Room. Those interested in attending should register by Nov. 23. Call the Rocky Mountain Adoption Exchange on 296-4017.

A special screening of Kevin Costner's new movie, "Dances With Wolves," will be held Sunday, Nov. 18, at the Winrock Theatre at 4 p.m. to benefit Futures for Children. Futures for Children is a self-help organization working with American Indians in New Mexico, Arizona, and elsewhere in

the Americas. Tickets are \$10/person and may be purchased 30 minutes before the film begins.

Journalist James Burke looks at global warming from the perspective of the year 2050 on "After the Warming," a Public Television special at 9 p.m. Wednesday, Nov. 21, on KNME-TV Channel 5. "After the Warming" incorporates the latest electronic technology, allowing Burke to report from the future. A simulation device called a "virtual reality model" uses graphic visualization to show how the buildup of the earth's atmosphere affected life on the planet "back in the 1990s" and beyond.

The LAB NEWS is interested in how Sandians spend their lunch breaks besides eating lunch. We're planning an upcoming photo feature. Have you been playing the same game of chess for three

years? Do you climb the stairs for 30 minutes of exercise? If someone you know does something different or interesting, we'd like to know about it. Please call Mark Poulsen (3162) on 4-5605.

Retirees not shown in LAB NEWS photos include Elaine Howard (9310), Clarence Huddle (5213), Theresa Phelps (152), Merrill Palmer (9312), and Pedro Armijo (7818).

Fun & Games

Fun Run — The third annual Jingle Bell Jog benefiting the Designs for Learning Differences (DLD) School will be held Saturday, Dec. 1. Four featured events include a 10K run, 5K run, 5K race walk and a one-mile fitness walk with Santa. Call the DLD School on 822-0476 for information.

UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS • UNCLASSIFIED ADVERTISEMENTS

Deadline: Friday noon before week of publication unless changed by holiday. Mail to Div. 3162.

Ad Rules

1. Limit 20 words, including last name and home phone.
2. Include organization and full name with each ad submission.
3. Submit each ad in writing. No phone-ins.
4. Use 8 1/2 by 11-inch paper.
5. Use separate sheet for each ad category.
6. Type or print ads legibly; use only accepted abbreviations.
7. One ad per category per issue.
8. No more than two insertions of same "for sale" or "wanted" item.
9. No "For Rent" ads except for employees on temporary assignment.
10. No commercial ads.
11. For active and retired Sandians and DOE employees.
12. Housing listed for sale is available for occupancy without regard to race, creed, color, or national origin.

MISCELLANEOUS

LABRADOR PUPPIES, yellow, AKC-registered, ready to take home Dec. 2. Jakubczak, 892-6322.

BRIDGESTONE POTENZA TIRE, P215 60R15, raised black letters, for 300ZX, 35K-mile tread, paid \$138, sell for \$45. Hagerman, 275-3326.

DP POWER TRAC 200 TREADMILL, adjustable speed and incline (0-4 mph), \$175; DP Body Tone 300 multi-gym, rowing, bench presses, squats, \$75. Weagley, 821-4263.

VIVITAR MARCO ZOOM: new 28-70mm lens (Olympus mount), f/3.5-4.5, aperture range f/3.5-f/22, includes UV filter, \$95. Brewster, 898-0144.

SHEEPHERD'S TENT, w/stove, \$150; Remington model 788, w/4x12 scope, \$400; trampoline, 48-in., \$10. Baker, 294-3334.

INDIAN NECKLACE, \$200 OBO; diamond cocktail ring, \$100 OBO; Hartman luggage, 3 pieces, \$200 OBO; Scandinavian rug, 3' x 5', \$100; exercycle, \$100. Ryburn, 897-1733.

WOOD STOVE, \$195. Cibicki, 877-7098.

SEASON TICKETS, Lobo basketball, northwest section of arena, near floor, Section 23, Row 32, \$236. Sanchez, 299-0443.

PORTABLE ELECTRIC TYPEWRITER, Smith-Corona Coronamic; Buddy Easywriter 210 children's typewriter, extra ribbons; Schwinn scooter, hot pink, w/white handlebars. Wagner, 823-9323.

POOL TABLE, 7-ft., \$175; 4-ft. doghouse, \$10; miscellaneous. Myers, 265-7293.

ZOOM LENS, 75-200, Vivitar, auto-focus, works on non-AF Nikon camera, \$175. Casper, 268-4464, leave message.

FIBERGLASS INSULATION BUTTS, 6-in. thick (R-19), \$20 for 8. Barnard, 256-7772.

QUILTED BEDSPREAD, king-size, peacock design, cost \$300, sell for \$90; king-size sheets, mattress pad, \$35; child's nylon sleeping bag, \$25. Biffle, 293-7043.

BOOKS: *Target Germany: USAAF Bombers' First Year Over Germany*, \$10; *Yarnfield Yank: 70th Repple-Depple Stone*, \$8; *AAF Class 42-J, Primary Flight School Corsicana*, \$3. Harris, 255-6577.

HOCKEY SKATES, man's size 10, Bauer Black Panther, \$20 OBO. Filter, 823-1232.

HOTPOINT REFRIGERATOR, 1.6-cu.-ft., dorm-type, \$55; AT&T Nomad 4000 cordless phone, \$30. Adelman, 292-0563.

BOXER PUPPIES, AKC-registered, dark fawn and brindle colors, parents on premises, \$200-\$225. Owenby, 281-9688.

AIRLINE TICKETS, round-trip, Albuquerque to San Diego, leave Nov. 21, return Nov. 26, \$100/ea. Foty, 268-0412.

PUPPIES, pure-bred Lhasa-Apso, 4 males, 4 females, parents on premises, grandparents champions, born Oct. 3, health guarantee offered, \$285. Kuehn, 281-2727.

GITARS: Suzuki inlaid and numbered 12-string, \$100; Goya vintage 12-string, \$50; each w/original case. Dybwad, 296-9047.

MAPLE STUDENT DESK, \$25. King, 821-4692.

SEARS WATER SOFTENER, \$50; pickup bed liner. Matthews, 869-2370.

COMPAQ COMPUTER, 640K RAM, 10-MB hard disk, two 360K floppy drives, DOS, clock, \$550. Cuyler, 292-8076.

NANDAY CONURE, black head, w/cage, \$50. Bruce, 897-7416.

CLOTHES DRYER, Sears Lady Kenmore, \$50. Brigham, 292-4399.

SHOP MANUALS, complete set, for all '74 Ford trucks, includes wiring diagrams for the F-250, \$50 firm. Bosworth, 869-6949.

SPA/SWIMMING POOL GAS HEATER, Teledyne Laars, 125,000-Btu, \$250; 8-ft. patio door, double insulated, bronze finish, \$150. Matthewson, 883-6649.

SKIS, new, Pre Team 800, 170cm, bindings never mounted, \$50. Norwood, 292-0072.

KIRBY UPRIGHT VACUUM CLEANER, w/all attachments, \$70; 2 hanging porch swings, \$15/ea. Newman, 266-6928.

NINTENDO POWER GLOVE, used twice, \$70 OBO. Chino, 867-5170 evenings.

ANTIQUA DESK, solid pine, carved handles, Southwest look, \$138. Ramel, 821-0475.

KITTENS, 2-mos. old, 2 black & white w/white paws, free. Lee, 836-4353.

KENMORE WASHER, heavy-duty, large-capacity, white, 3 cycles, 2 water levels, \$60; kindling, \$5. Parr, 892-5618.

SKIS, 195cm, TUA racing RS, used 5 times, \$75 OBO; king-size bed-frame, steel, new, low-boy style, \$35 OBO. Baron, 296-4279.

WALL-TO-WALL CARPETING, 12' x 12', blue, \$40; 2 rocker highback chairs, \$35/ea. Navratil, 293-5527.

VACUUM CLEANER, Kirby Heritage II, w/attachments, \$300; 19-in. color TV, \$100; four-horse Hot-Walker, w/motor, \$1,500. Coleman, 299-8321.

TRUCK CAP, Glasstite for Toyota pickup, black, \$200. Tomlin, 293-0004.

RADIO-CONTROLLED CAR, \$75; Dremel tool, \$60; chain saw, \$25; stereo receiver, \$75; lawn edger, \$25; chest freezer, \$250. Howard, 839-9203.

JOINER/PLANER, Craftsman, solid cast-iron, 6-1/8-in.-wide cut, 3/4-hp, w/steel leg set, \$200. Schindwolf, 831-1940.

BLACK LABRADOR PUPPIES, AKC-registered, 6 wks. old, 3 males, 3 females. Gutierrez, 892-7142 evenings.

DINING TABLE, solid light cherry wood, 6 chairs, hutch/buffet, \$300; Head skis, Salomon 444 bindings, \$40. Crow, 821-0956.

TWIN BED, w/trundle, \$50; chocolate vinyl couch, w/chair, \$150; round dining table, w/leaf, 4 chairs, \$50. Young, 298-6449.

Deadline Change

The next LAB NEWS will be published Dec. 7. Deadline for ads and other submissions is noon, Friday, Nov. 30.

DOWN JACKET, Eddie Bauer, woman's size 12, mouton lamb, w/hood, never worn, \$150. Powell, 268-8607.

SOFA SLEEPER, queen-size, oatmeal color, \$125; queen-size mattress, w/box springs, \$50; queen-size waterbed, complete, \$75; 4-drawer chest, \$20. Hudson, 298-3935.

GIRL'S SKI JACKET, junior size 16, turquoise/black & white, \$30. Plummer, 296-4327.

SNOW CHAINS, 1 set, for tire sizes 7:00-14 through 195R15, \$20. Schubeck, 821-3133.

OAK DESK, \$150; chair, \$25; unpainted 9-drawer dresser, \$120. Pott, 291-0261.

DALMATION PUPPIES, AKC-registered, show quality, champion blood lines, shots, whelped Sept. 7. Aeschliman, 281-1227.

DIAMOND, 1.00-carat, emerald cut, VS-1 clarity, H color, cost \$5,500, sell for \$3,500. Davis, 296-6022 (880-6022 pager).

MICROWAVE, Sears, probe, \$60; 4 Danish chairs, w/blue-gray upholstery, \$125. Spires, 275-3655.

TWIN BED, complete, 2 sets of sheets and pad; La-Z-Boy recliner; woman's dress shoes, size 6-1/2 AAAA. Wilson, 821-1570.

EXERCYCLES, \$25 and \$45; rowing machine, \$25; 2 swivel stools, \$20/ea. Bentz, 299-3448.

ROOM RESERVATION for 2 at Bally Hotel in Las Vegas, Dec. 23-28, transferable but not refundable, \$149. Schowers, 828-8494.

TRANSPORTATION

'76 CHEV. MALIBU, 4-dr. sedan, 350-CID, AT, PB, PS, 78K miles, \$1,400. Hesch, 275-7630.

'82 CADILLAC ELDERADO BIERITZ, 2-dr., sunroof, AT, PS, PB, AC, CB radio, gold. Montoya, 881-6898.

'78 PONTIAC BONNEVILLE, PS, PB, PW, 301 V-8, AM/FM, cruise, tilt, one-family car, maintained regularly, \$1,600 OBO. Troncoso, 897-1167.

'80 LUV PICKUP, FWD, AM/FM cassette, \$2,500. Calek, 897-4038.

'89 KAWASAKI BAYOU 4-WHEEL ATV, red, single/dual traction, 6 hours riding time, \$3,100 OBO. Chavez, 899-8695 or 884-7909.

'84 MONARCH 16SV BOAT, 55-hp Evenrude, trailer, \$3,450. Matthews, 869-2370.

'81 BUICK CENTURY STATION WAGON, loaded, 65K miles, \$2,195. Biedscheid, 294-6564.

'83 S-10 PICKUP, AT, AC, AM/FM radio, w/camper shell, \$2,500. Benton, 877-2473.

'79 FORD MOVING VAN; '75 Chev. Surburban; '55 Dodge. Bruce, 897-7416.

'85 CHEV. PICKUP, 4x4, Silverado package, loaded, custom rims, lift included, 66K miles, \$7,600 OBO. Flowers, 298-0681.

'86 DODGE PICKUP, 4x4, Royal SE package, matching shell, loaded, 23K miles, \$11,500. Cincotta, 296-6022.

SCHWINN LeTOUR BICYCLE, 10-spd., 23-in., center pull brakes, \$75; Bianchi 24-in. 12-spd. bicycle, \$100. Hachigian, 298-1414.

'87 NISSAN PICKUP, 4x4, V-6, 5-spd., PS, PB, AM/FM cassette, 47K miles, burgundy, \$6,800. Tempel, 892-9525.

'84 LINCOLN TOWNCAR, Signature series, 25K miles, \$6,700. Caskey, 298-6428.

'83 CHEV. MALIBU, V-6, 52K miles, original owner, new rear tires, cruise, \$2,700. McCall, 266-4483.

'83 YAMAHA YZ250 DIRT BIKE, \$650 OBO. Howard, 839-9203.

'72 CHEV. K5 BLAZER, 4x4, 350 V-8 engine, stereo, \$3,500 OBO. Randall, 299-3935.

'72 VW BUG, turquoise, restored, 10K miles on rebuilt engine, AM/FM cassette, \$2,450. Mansure, 821-4898.

ROADMASTER 10-SPD. BIKE, 26-in., \$30. Newcom, 293-5180.

'88 GMC C2500 3/4-TON PICKUP, 4.3L V-6, AC, AT/OD, cruise, PS, PB, limited-slip differential, transmission cooler, 23K miles, white, \$9,250. Spence, 266-0924.

'81 TOYOTA COROLLA, 2-dr., silver, 5-spd., AC, \$1,200. Heald, 281-8826.

FUJI ESPREE TOURING BICYCLE, 2 yrs. old, needs overhaul, tires, \$100 OBO. German, 247-2882.

REAL ESTATE

2-BDR. TOWNHOUSE, 2-story, 1-3/4 and 1/2 baths, near KAFB, assumable, no qualifying FHA loan, \$69,000. Hesch, 275-7630.

2-BDR. HOME, near KAFB, garage, 9-1 1/2% assumable, no qualifying. Bouchard, 265-8148.

4-BDR. HOME, Campus & Lafayette NE, near schools, concrete block, 2,500 sq. ft., 1-3/4 baths, security bars, 6-ft. wall, double garage, \$105,000. Myers, 265-7293.

2-BDR. PATIO HOME, 2 baths, 1,369 sq. ft., 4 yrs. old, Spain and Morris area, near park, \$101,000. Wolf, 296-1588.

3-BDR. MOBILE HOME, at Vineyard Retirement Park, 1-3/4 baths, 1,440 sq. ft., fireplace, storage area. Rael, 345-1084.

WANTED

FEMALE ROOMMATE, nonsmoker, share 3-bdr. house near Indian School and Girard NE, split rent and utilities. Adams, 296-2455.

ULTRASONIC CLEANER TANK w/heater, prefer controller model but can use other, 2- to 6-qt. size. Rodriguez, 296-3277 after 5 p.m.

BABYSITTER, occasional overnight, to help handicapped 23-yr.-old (capable of self-care), also feed 3 dogs. Flanagan, 891-3728 after 6 p.m.

USED ROTOTILLER; bagged leaves for compost pile; 5+ hp motor w/horizontal shaft. Greer, 281-4688.

GOOD HOME(S) FOR PUPPIES: 3-mo.-old female, black mixed breed; 4-mo.-old female, white short-haired mixed breed, spayed and has all shots. Rex, 344-6552.

VEHICLE w/'70 or older 455 Pontiac engine. Prevender, 296-8586.

CHILDREN'S BOOKS, in good condition, for kindergarten through third grade, small storybook type. Vigil, 899-0046.

SKI RACK, for Bronco II, top-mount for 4 sets of skis, must lock. Jewell, 293-4838 after 5 p.m., anytime on weekends.

HOUSEMATE, share 3-bdr. home, 2 baths, kitchen & laundry facilities, fireplace, landscaped yard, utilities included. Howard, 839-9203.

PING-PONG TABLE. Walston, 298-1500.

ROOMMATE, share 4-bdr. home, 2 baths, in Sandia Knolls area. Tafoya, 281-1454 after 9 p.m.

PRINTER, Star SG-10, 9-pin, or equivalent. Dunn, 298-6278.

WORK WANTED

HOUSESITTING, UNM senior available for housesitting, references furnished. Jones, 298-4741.

Coronado Club Activities

Like Snowy Weather? Try Tonight's Dinner

ARE YOU WISHING FOR MORE WHITE STUFF? You will be after you try the kitchen's special snow crab tonight for only \$8.50. Or keep warm with the other special menu items: chicken teriyaki or beef burgundy (both two-for-one priced at \$10.95), prime rib (\$7.95), and filet mignon (\$8.95). The Isleta Poor Boys play from 8 p.m. to midnight, and the drink specials (both very chilly) are longneck Buds (\$1) and jumbo margaritas (\$2.50). Reservations recommended (265-6791).

THESE FOLKS SURE ARE — wishing for snow, that is. The Coronado Ski Club's next meeting features a guest lecture by Dr. Charles Bova, an expert in occupational and sports medicine from Lovelace Medical Center. His talk is entitled "Con-

ditioning for the Ski Season and How to Handle Ski Injuries." The social starts at 7 p.m., and the talk starts at 7:30. Snacks and superlative door prizes will make the evening even sweeter.

BARGAIN HUNTERS BRACE YOURSELVES, because the day after Thanksgiving is the biggest shopping day of the year. Why not take advantage of the "quiet before the swarm" at the pre-turkey-day lunch. Between 11 a.m. and 1:30 p.m. Wednesday, Nov. 21, the Club's regular lunch line tempts you with "turkey and all the trimmin's" (\$4.50 per person).

SPEAKING OF TURKEYS, why not be the early bird and catch the Club's special Sunday

brunch, Nov. 25. Fill up on scrambled eggs, omelets, sausage, bacon, french toast, pancakes, ham, turkey (please, no more), beef, salads, desserts, champagne, and green chile stew (\$5.95 for adults, \$2.50 for children 4 to 12 years old, and free for toddlers).

DANCE NOVEMBER'S LAST DANCE to the music of the Isleta Poor Boys Friday, Nov. 30, from 8 p.m. to midnight. Weekend-night activities at the Club will be slowing down in December (the next one is the Christmas party), so don't miss tonight's fun. The menu includes prime rib, broiled salmon steak (both two-for-one at \$14.95), enchilada plate (\$5.95), beef fajitas (\$6.95), and tuna albacore (\$7.95). Tequila sunrises are \$1 all night.

Events Calendar

Events Calendar items are gathered from various sources. Readers should confirm times and dates of interest whenever possible.

Nov. 16-17 — "She Loves Me," Broadway musical comedy set in a European parfumerie in the 1930s; 8 p.m. Fri.-Sat., 2 p.m. Sun.; Albuquerque Little Theatre, 242-4750.

Nov. 16-17 — ASUNM 20th Annual Christmas Arts & Crafts Fair, more than 70 exhibitors, entertainment; 9 a.m.-6 p.m., UNM Student Union Ballroom, 277-6544.

Nov. 16-17 — Classical Concert 3, New Mexico Symphony Orchestra performs "Overture to the Secret of Suzanne" by Wolf-Ferrari, "Violin Concerto No. 1" by Paganini, and "Symphony No. 6 in B Minor" by Shostakovich; 8:15 p.m., Popejoy Hall, 842-8565.

Nov. 16-17 — "Memorandum" by Vaclav Havel, witty assault on bureaucracy, winner of the 1967-68 Obie Award for best foreign play, presented by Theatre-in-the-Making; 8 p.m., CenterStage (3211 Central NE), 260-0331.

Nov. 16-18 — Tenth Annual Holiday Ogle, holiday arts and crafts show and sale, sponsored by the Junior League of Albuquerque; 7-10 p.m. Thurs. (preview night, \$25/person), 10 a.m.-8 p.m. Fri. & Sat., 10 a.m.-5 p.m. Sun.; East Exhibit Hall, Albuquerque Convention Center, 247-1800.

Nov. 16-Dec. 9 — "The Winter's Tale," Shakespeare's magical medieval fairy tale, combines tragedy with comedy, loss with restoration, dying with rebirth;

8 p.m. Fri.-Sat., 6 p.m. Sun.; Vortex Theatre, 247-8600.

Nov. 17 — Holiday Arts and Crafts Bazaar, hand-crafted items, more than 100 participants; 9 a.m.-4 p.m., Cleveland Middle School (6910 Natalie NE, corner of Louisiana and Montgomery), 884-8567 or 881-0050.

Nov. 17 — Alternative Christmas Market, local handmade crafts and peacecrafts (all profits from sales are returned to native crafters in Central America and other countries), green chile stew, baked goods; 9 a.m.-4 p.m., La Mesa Presbyterian Church (7401 Copper NE), 255-8095.

Nov. 17 — Opening night celebration and exhibit preview for "Wolves and Humans," Acoma Pueblo dancers, music from the Andes, auctions, food; 7-10 p.m., New Mexico Museum of Natural History, 841-8838 for ticket information.

Nov. 18-April 14 — Exhibit, "Wolves and Humans," from the Science Museum of Minnesota, provides comprehensive picture of the social, biological, and mythological relationships between wolves and humans, partially funded by the National Endowment for the Humanities; 9 a.m.-5 p.m., New Mexico Museum of Natural History, 841-8837.

Nov. 18 — "Becoming A Man," YMCA program for 9- to 12-yr.-old boys and their parents; 2:30-5 p.m., 292-2287 for registration and information.

Nov. 21-25 — New Mexico Enchanted Arts and Crafts Show; call for times, Lujan Bldg., NM State

Fairgrounds, 265-1791.

Nov. 23-25 — Thanksgiving Celebration, traditional Indian dances performed by native dance groups; call for times, Indian Pueblo Cultural Center, 843-7270.

Nov. 23-25 & Nov. 30-Dec. 1 — "The Nutcracker" by Tchaikovsky, New Mexico Symphony Orchestra and the New Mexico Ballet Company; 7:30 p.m. Fri.-Sat., 2:30 p.m. Sat.-Sun.; Popejoy Hall, 842-8565 or 277-3121.

Nov. 24 — Wolf storytelling and book signing with Teresa Pijoan de Van Etten; noon-3 p.m., New Mexico Museum of Natural History, 841-8837.

Nov. 28 — "The Shalako," lecture by Edmund Ladd of Zuni Pueblo, sponsored by the Educational Committee of Friends of the Indian Pueblo Cultural Center; 7 p.m., Indian Pueblo Cultural Center, 247-4907.

Nov. 30 — Holiday Fair, Christmas plants, poinsettias, green wreaths, swags, Christmas cacti, 40 artists and craftspeople; 10 a.m.-6 p.m., free, Albuquerque Garden Center (10120 Lomas NE), 296-6020.

Nov. 30-Dec. 8 — "An Evening With Shakespeare," presented by Theatre-in-the-Making's Youth Performance Workshop; 8 p.m., CenterStage (3211 Central NE), 260-0331.

Dec. 5-16 — "Other People's Money" by Jerry Sterner, dramatic comedy about Main Street vs. Wall Street, presented by the New Mexico Repertory Theatre; 8 p.m. Tues.-Sat., 2 p.m. Sbyun.; KiMo Theatre, 243-4500.

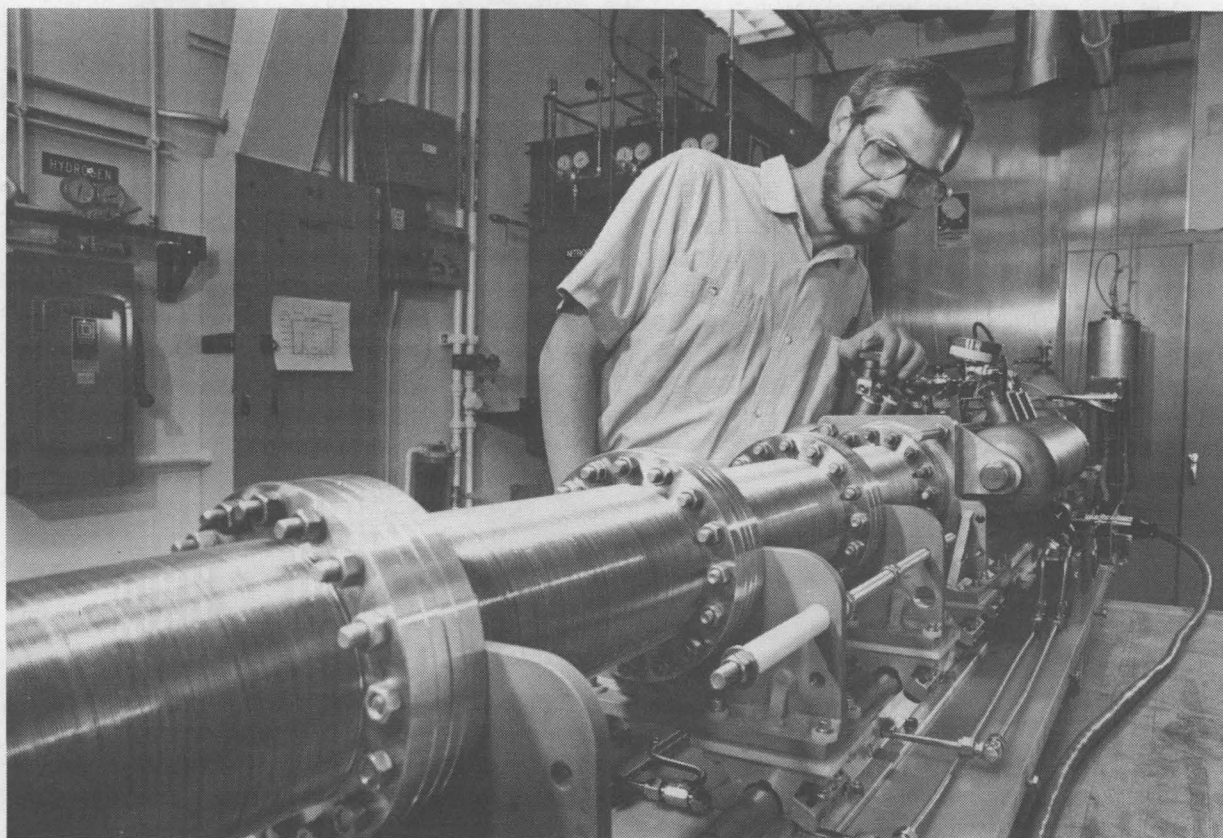
Fun & Games

Bowling — Attention, bowlers. Sandia and DOE employees and their spouses are eligible to join the SANDOE Bowling Association. Membership fee is \$4, which entitles you to bowl in SANDOE tournaments at a reduced rate. Members are also eligible for Bowler-of-the-Month awards. (Your series can be bowled with any sanctioned league — you do not have to be associated with a Sandia-sponsored league). For information, contact Dora Gunckel (6400) on 299-4867.

The tentative tournament schedule: Nov. 17-18, Best Ball, Fiesta Lanes; Dec. 9, Bowler-of-the-Year event, Galaxy Bowl; Jan. 19-20, Team Event, Holiday Bowl; Feb. 16-17, 4-Game No-Tap/Scotch Doubles, Fiesta Lanes; March 16-17, 4-Game Mixer, Galaxy Bowl; and April 13-14, 4-Game No-Tap, Holiday Bowl.

Winners of the 4-Game No-Tap Tournament Oct. 20-21 were Mike and Roni Montoya (guests) with a 1,532 combined handicap series. Second place went to Ron (2314) and Helen (Charlie) Husa with a 1,483 combined handicap series.

Grand Canyon River Trip — Retiree John Shunny is organizing his fourth annual Grand Canyon river trip for 1991, May 26 to June 3, Lee's Ferry to Lake Mead. The river outfitter discounts the price for organized groups (\$990 for this trip vs. a normal rate of \$1,200 to \$1,300). The nine-day trip includes meals and transportation back to Lee's Ferry from Lake Mead. Call John on 265-1620 (mornings) for more information.



PLASMA PHYSICIST Jonathan Watkins (6428) checks instrumentation on a fast-scanning probe designed at Sandia just before it was shipped off recently for use in magnetic confinement fusion research at General Atomics Co. in San Diego, Calif. The highly sensitive probe is a diagnostic device that measures plasma density, electron temperature, and floating potential inside the DIII-D Tokamak at General Atomics, which Sandia is using to conduct the research. A tokamak is a donut-shaped, magnetic bottle used to confine hot, dense plasma in fusion research. Ultimately, the probe will help scientists determine the amount of energy lost from fluctuations at the boundary of the magnetic confinement region.